

# Top 10 Energy Conservation Opportunities

## Reduced Flow Hoods to Fuel Cells

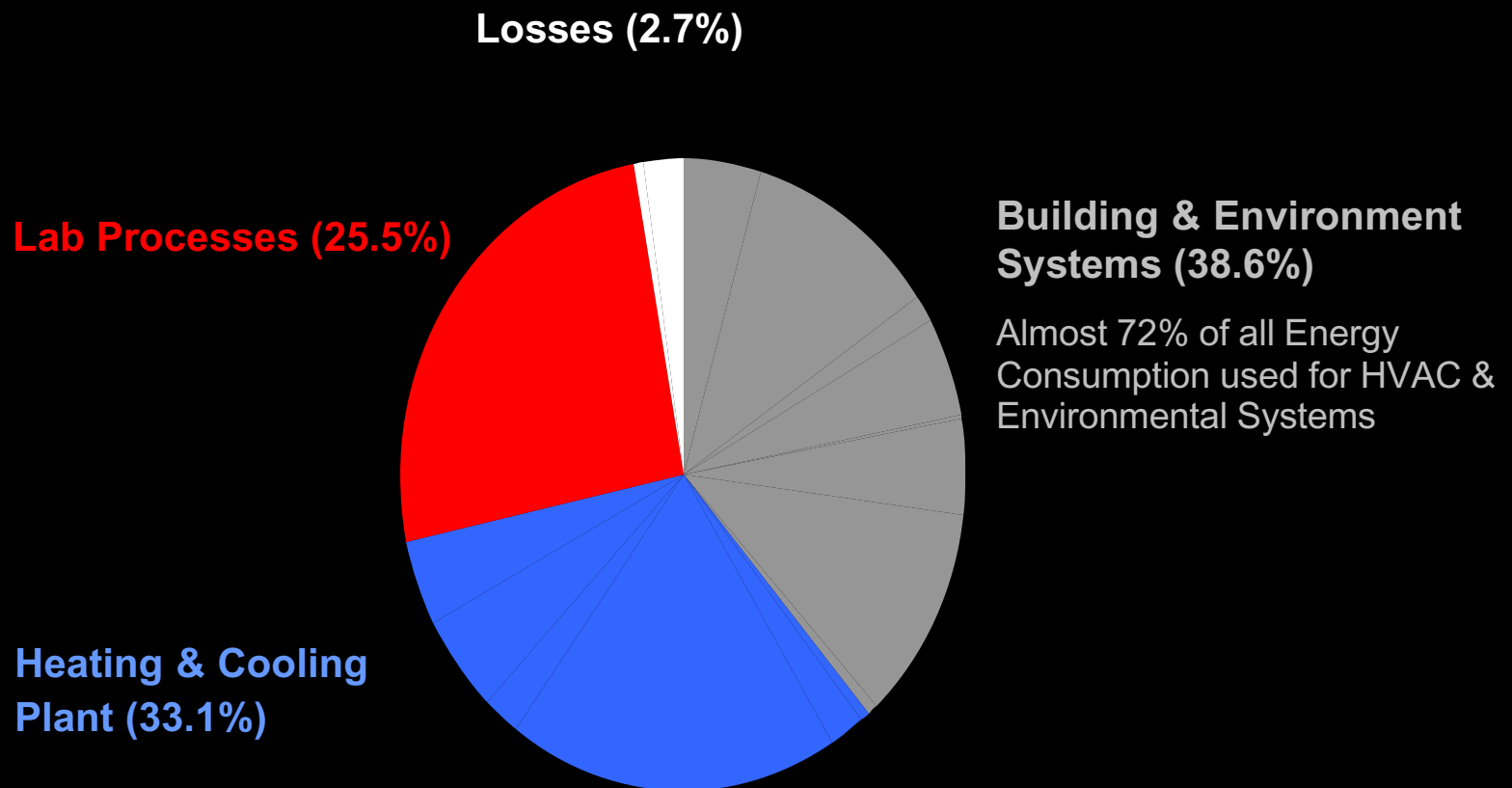


*presented by:*

† **Joseph A. Limpert, P.E.**  
**Mechanical Engineer**

# Total Purchased Energy Consumption

(Typical Research Building)



# Agenda

## ✚ Points of Focus

10. Reduced Flow Hoods
9. Air Change per Hour Reset
8. Heat Pipe
7. Mini-Cogen
6. Enthalpy Wheel
5. Daylight Harvesting
4. Commissioning

# Agenda

## ✚ “Not Quite Ready for Prime Time”

3. T-5 vs. T-8
2. Recirculating Lab Air
1. Fuel Cells

# Points of Interest

## † Typical Flows (Based on 100 fpm)

6' hood → 785 cfm

## † NFPA 1996 40 cfm / Linear Feet of Bench

6' hood → 240 cfm

## † NFPA 2000 25 cfm / Square Foot of Work Surface Within Hood

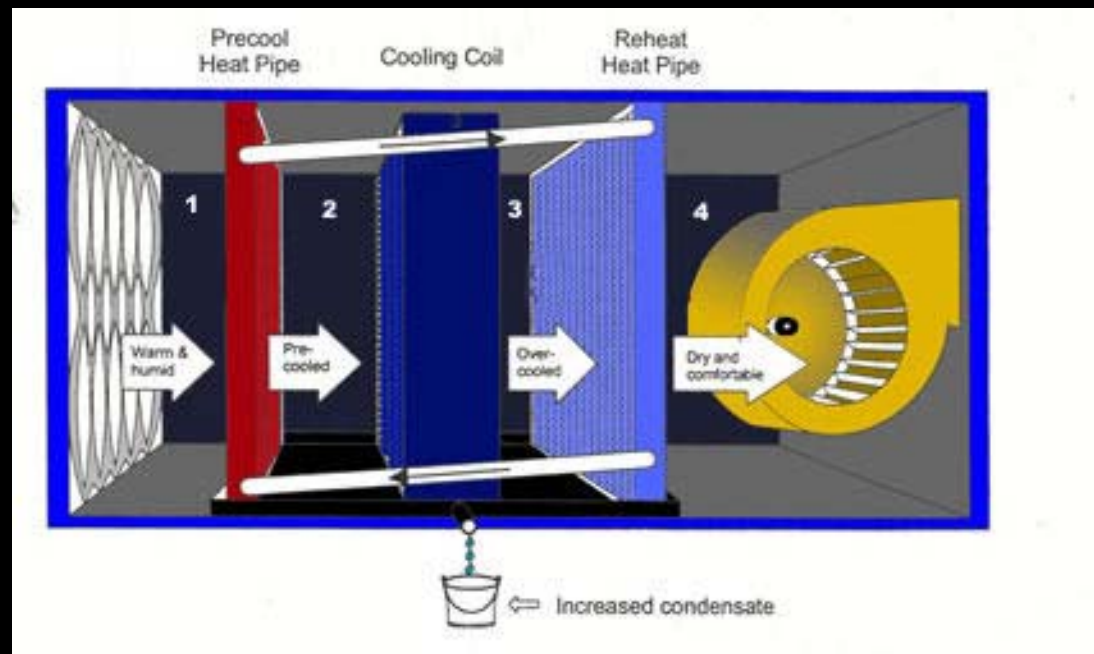
6' hood → 410 cfm Minimum 36" Depth

# #8 Point of Focus

## Heat Pipe

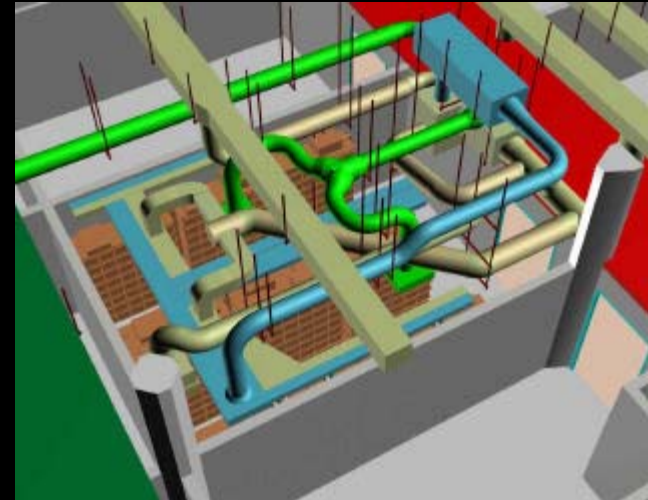
# What is a Wrap Around Heat Pipe?

† A refrigerant based heat exchanger (coils) located or “wrapped around” both sides of a cooling coil. The first coil yields cooling and the second coil produces reheat.



# Applications

- † **Clean Rooms, Animal Holding, Wet Laboratories**
- † **Use in Any High Percentage Outside Air-High Air Change Zone with Low Internal Heat Generation**
- † **Use to Reduce Cooling and Reheat Costs**



# Design Considerations

- † **Cooling Mode Specific**

- † **Space in Air Handling Unit Must be Allocated**

- † **Increased Pressure Drop**

- † **No Moving Parts**

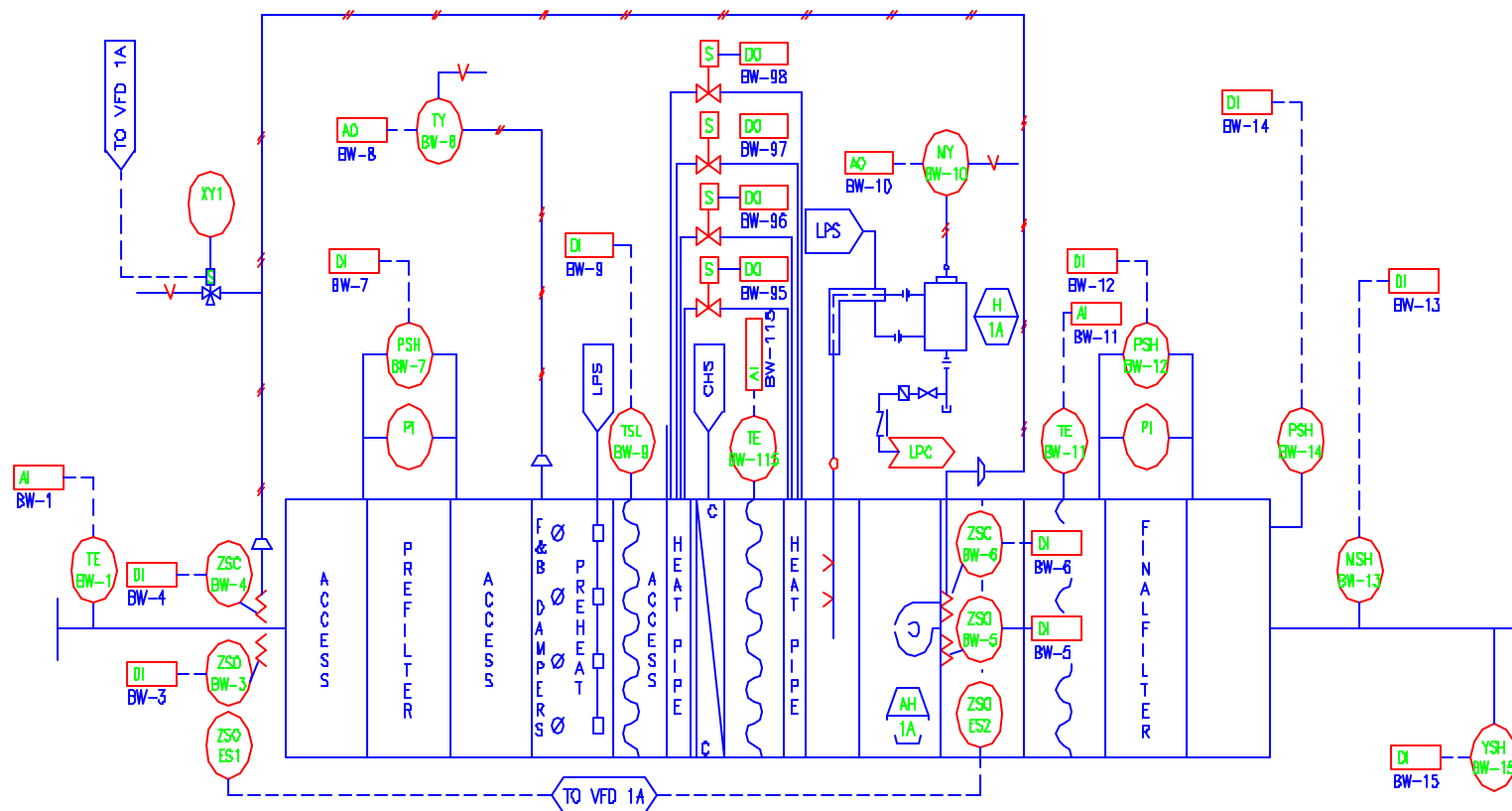
# Types of Wrap Around Heat Pipes

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† **Controllable**

† **Fixed**

# Controllable Heat Pipe



# *Case Study - Controllable Heat Pipe*

✚ Pfizer

✚ Vivarium

✚ Terre Haute, Indiana

✚ 110,000 CFM / 100% Outdoor Air



*Building 551 Vaccine Research Center*

# *Cost Analysis - Controllable Heat Pipe*

<b>Cost of Heat Pipes</b>	<b>\$125,000</b>
<b>Free Reheat Controlled from</b>	<b>0 – 15° F</b>
<b>Entering Air Enthalpy Reduced</b>	<b>0 – 24%</b>
<b>Energy Savings</b>	<b>\$40,300/yr.</b>
<b>Simple Payback</b>	<b>3.0+ Years</b>

# *Case Study* – Fixed Heat Pipe

† **UF Brain Gene Vector Laboratory**

† **cGMP Laboratory**

† **Gainesville, Florida**

† **12,000 CFM / 65% Outdoor Air**

# Cost Analysis – Fixed Heat Pipe

<b>Cost of Heat Pipes</b>	<b>\$21,000</b>
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<b>Free Reheat</b>	<b>0 – 8° F</b>
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<b>Entering Air Enthalpy Reduced</b>	<b>0 – 18%</b>
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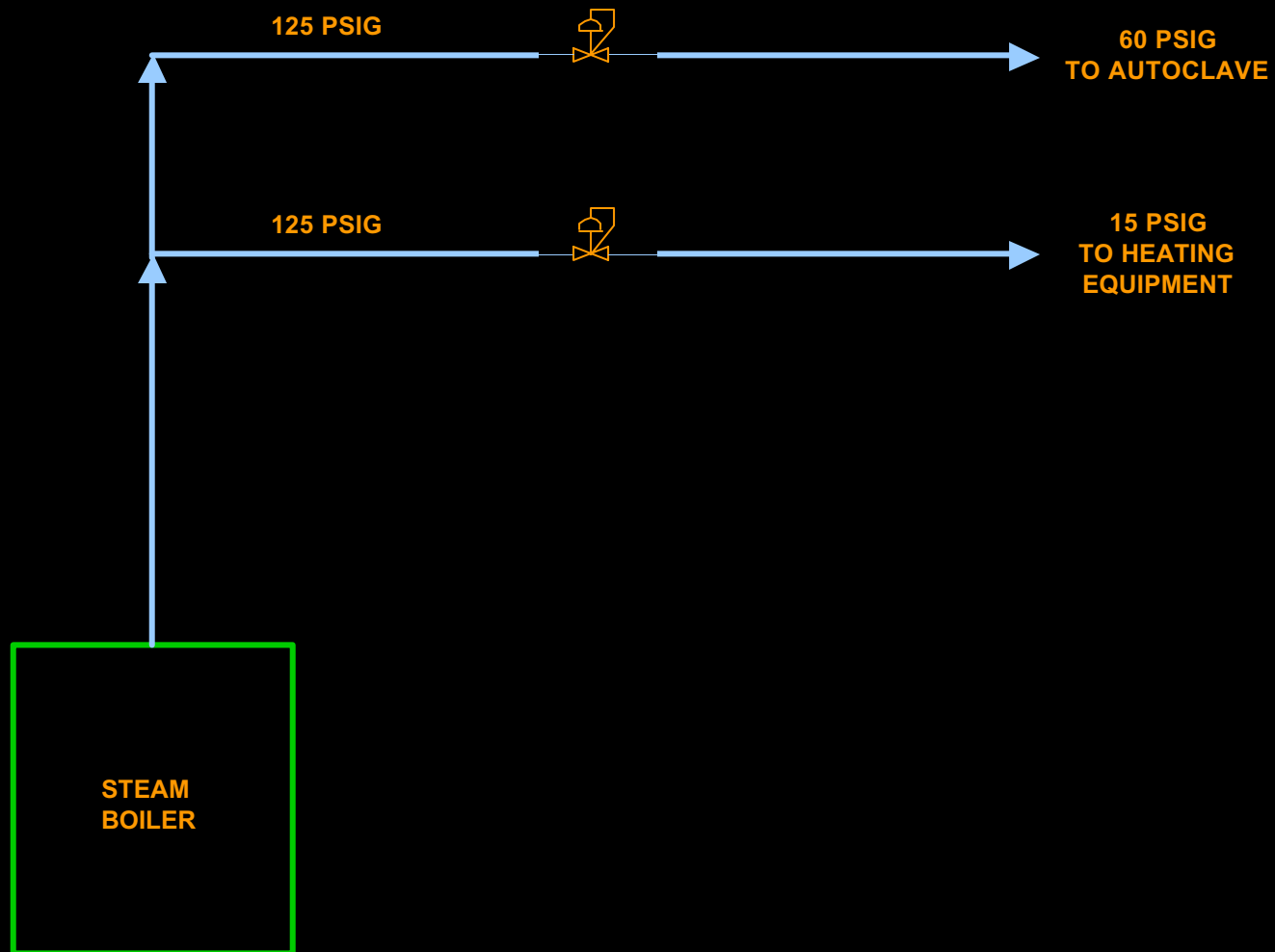
<b>Energy Savings</b>	<b>\$9,800/yr.</b>
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<b>Simple Payback</b>	<b>≅ 2.1 Years</b>
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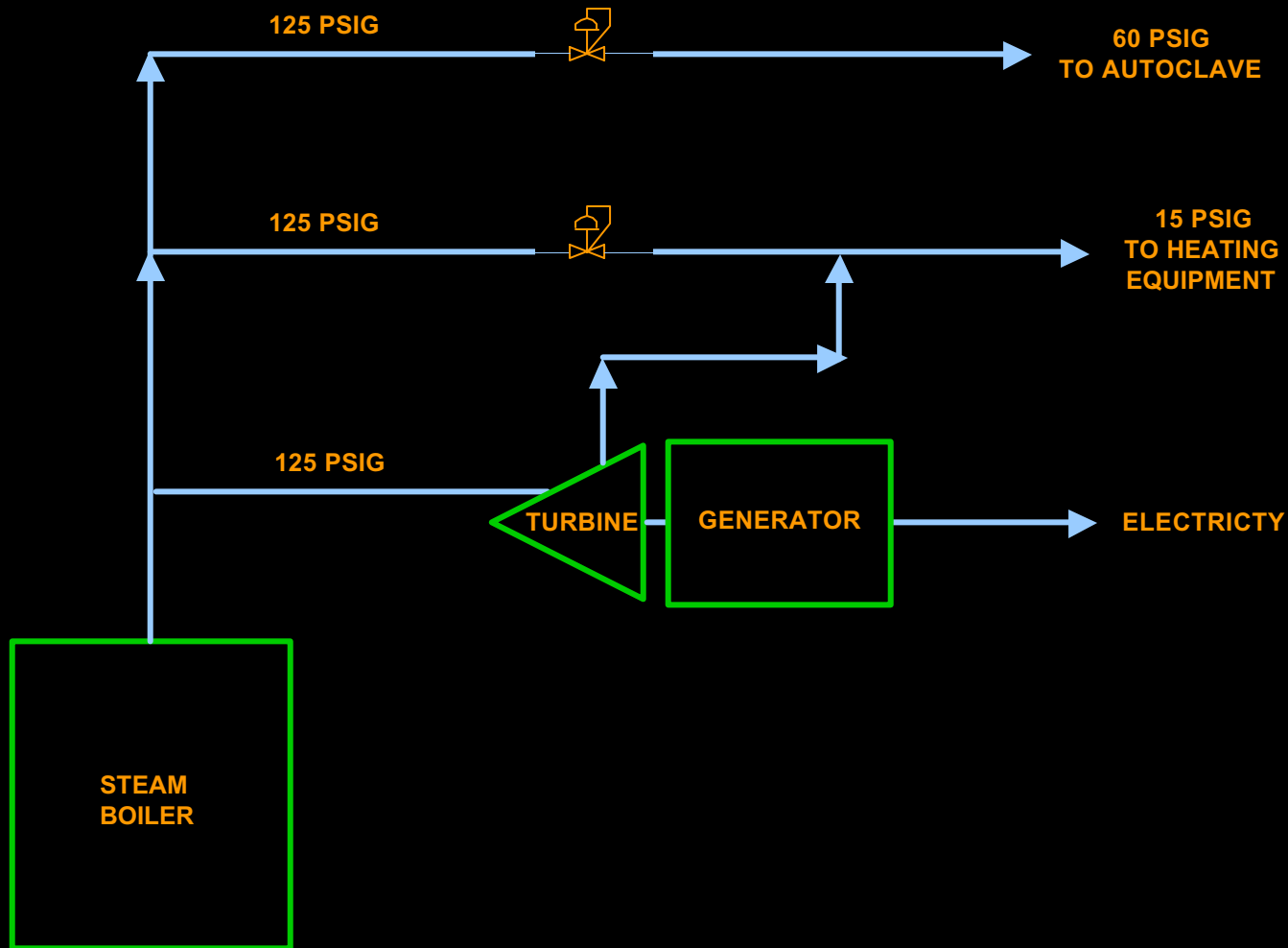
# #7 Point of Focus

## Mini-Cogen

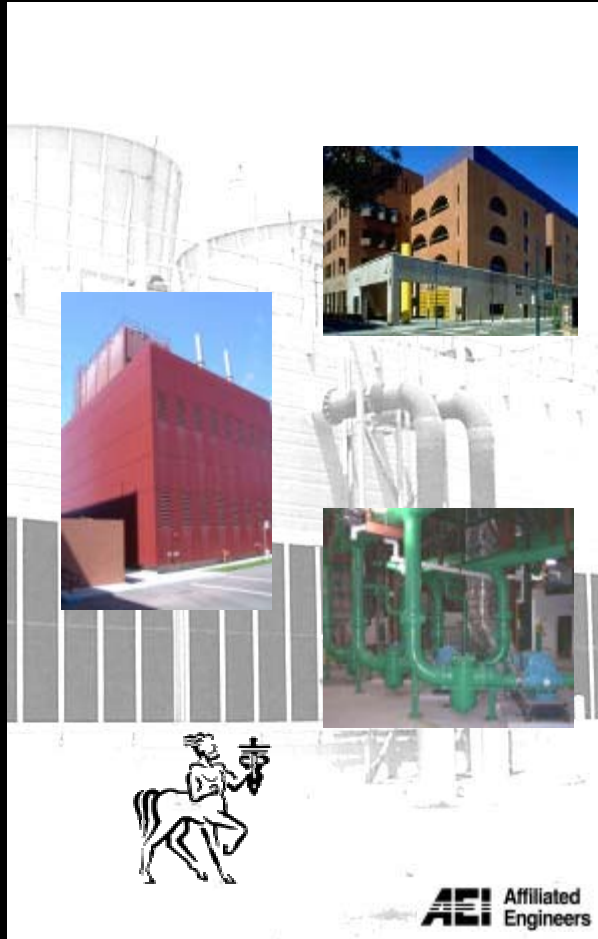
# Typical Steam Pressure Reduction



# Mini-Cogen System



# Micro-Cogen System



## † Case Study - Chiron

### Chiron Building 3

350,000 s.f.  
Biological/Vivarium/  
Chemistry/Office

100 KW

\$155,000

\$115,000

1.3 yrs

Size

First Cost

Annual Savings

Simple Payback

### Chiron Building 4

300,000 s.f.  
Biological/Chemistry/  
Office

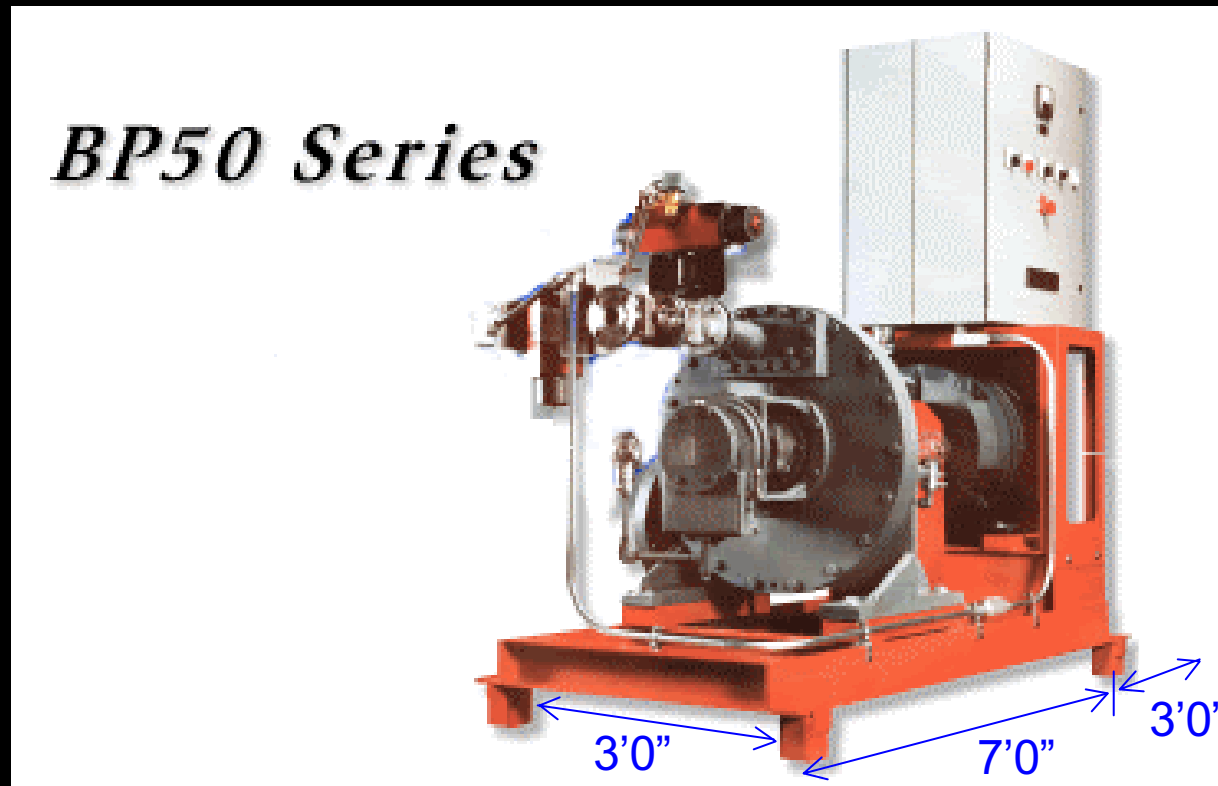
70 KW

\$155,000

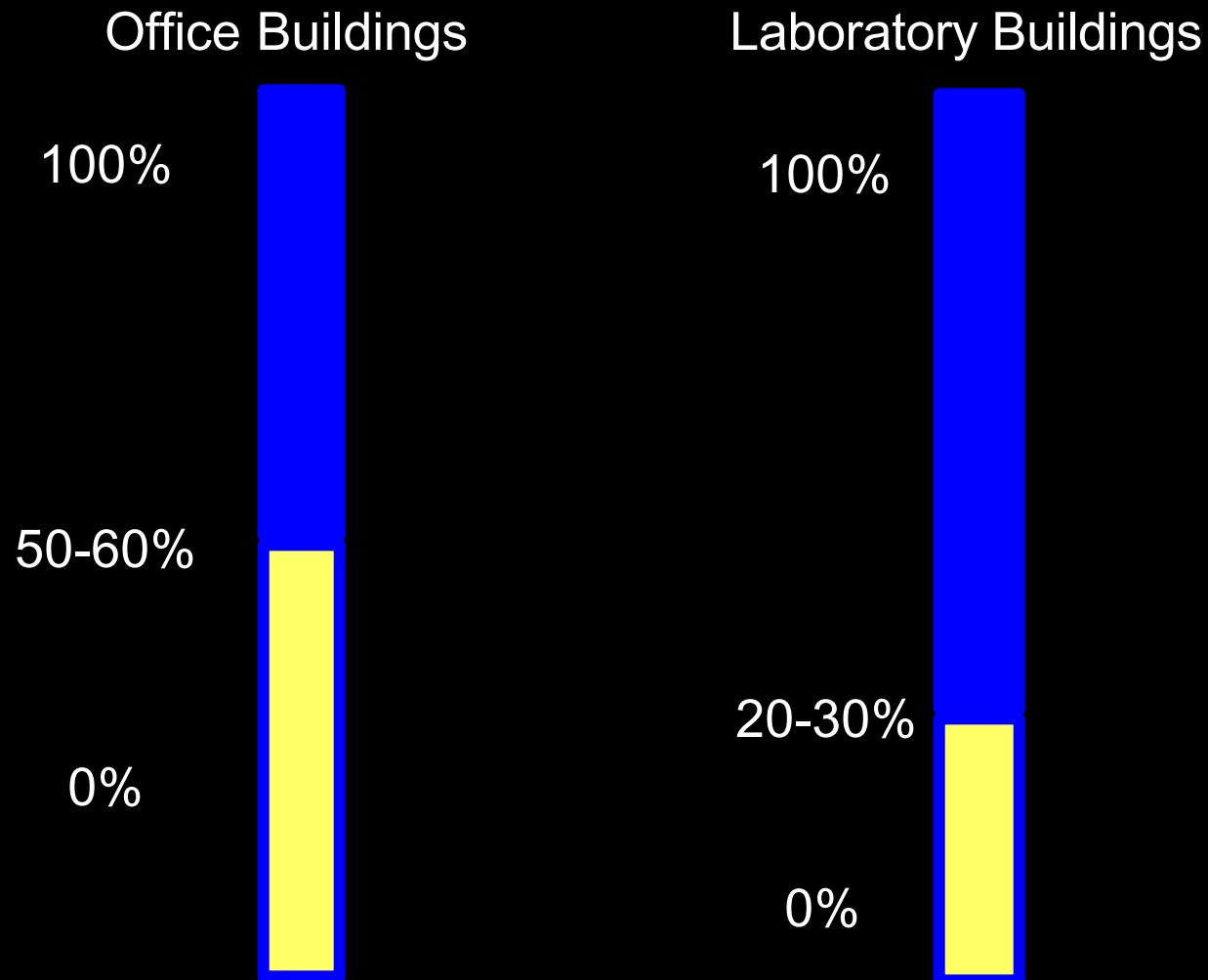
\$60,000

2.5 yrs

# 50-150 kW Similar to Chiron Building 4 and Building 3



# Lighting and Associated HVAC Cost as a Percentage of Total Energy Cost



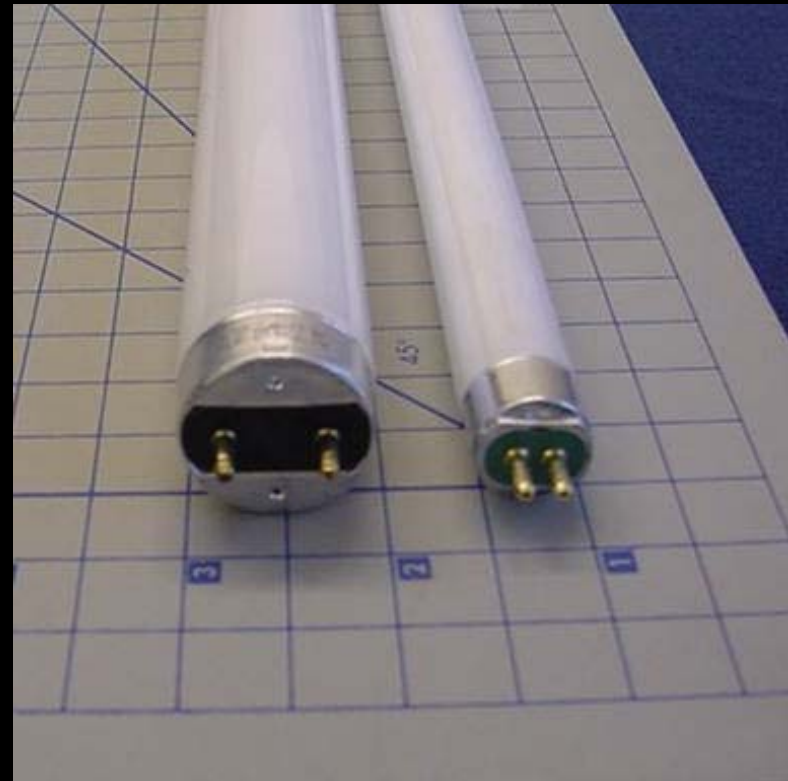
# # 3 "Not Quite Ready for Prime Time"

## T-5 vs T-8

# T-5 vs T-8

✚ What is a T-5?

✚ What is a T-8?



# Direct/Indirect Fixtures in Laboratories

† Chiron

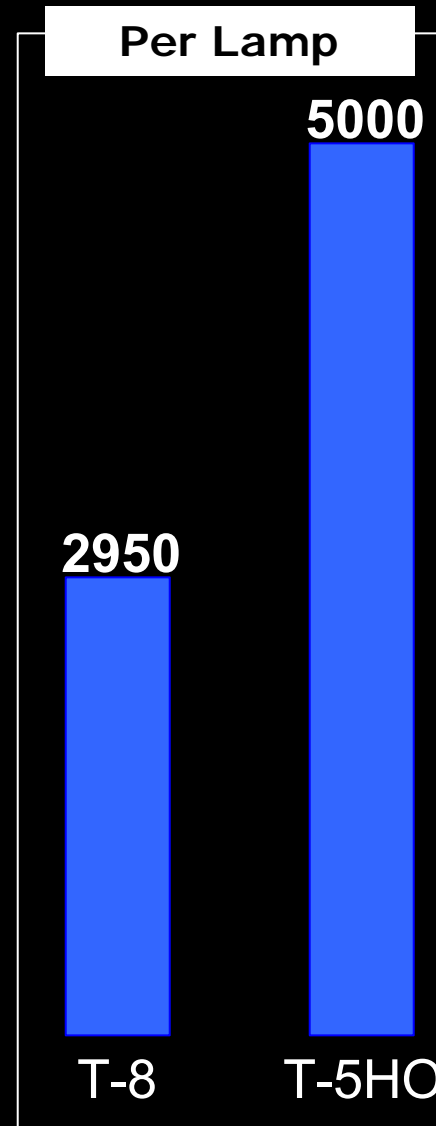
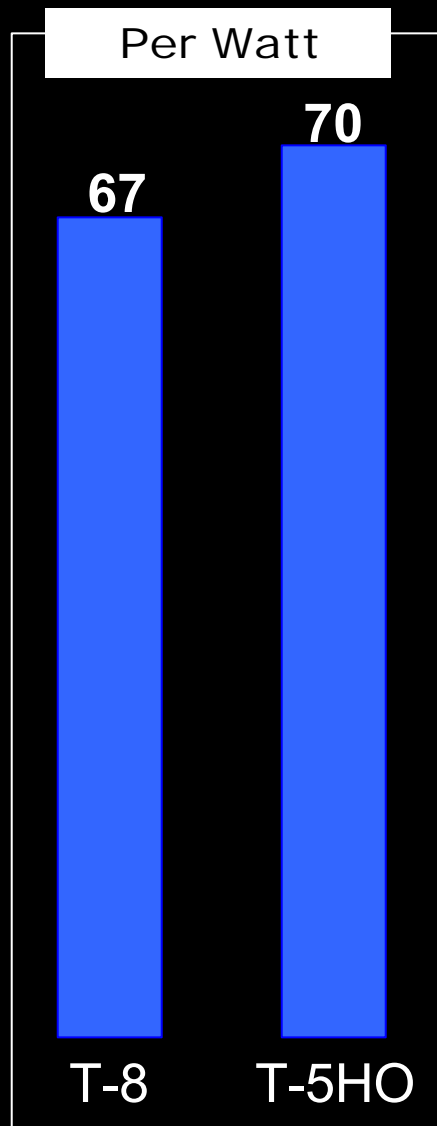
† Bayer 27 and 36

† SC Johnson

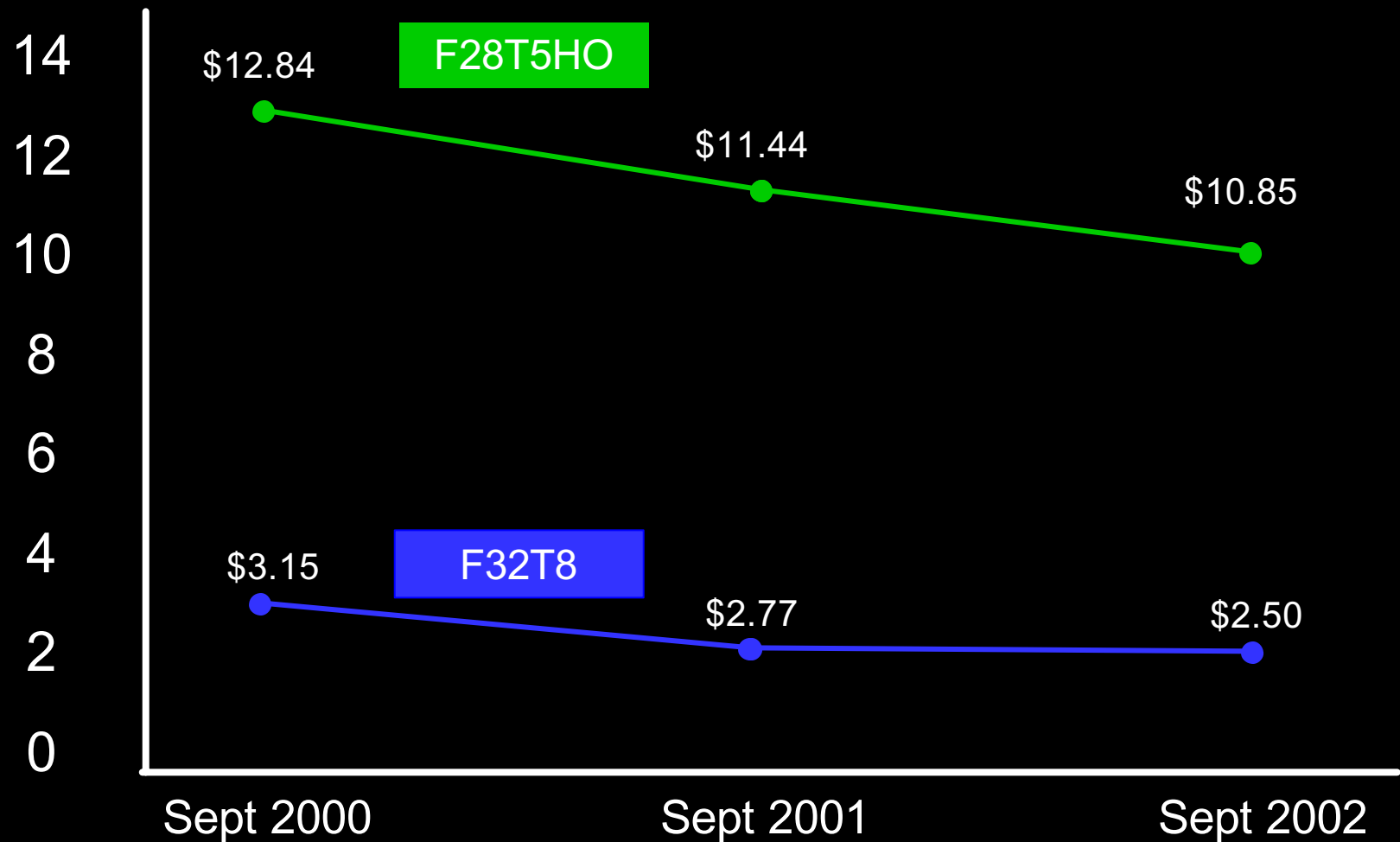
† Immunex



# Lumens



# Lamp Cost



# University of Cincinnati – CARE

† Comparison Model 2,203 sq. ft.

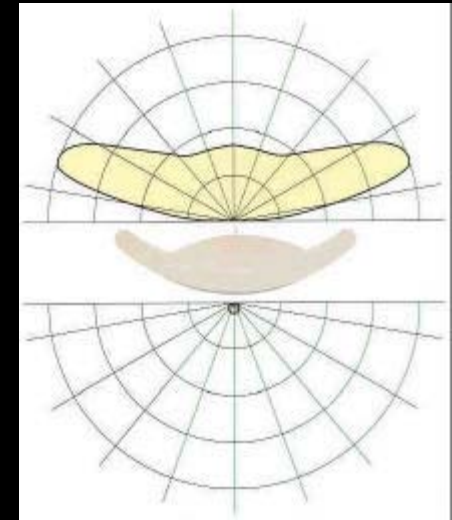
† ASHRAE 90.1 (LEED Requirements)

† 1.8 Watts/Square Feet

Case	Fixture	Lamp	Watts/sq.ft.
1	1x4 Parabolic Louvered Trotter	T-8 Long	1.86
2	Suspended, Direct/Indirect Louvered	T-8 Long	1.86
3	Suspended, Direct/Indirect Louvered	T-5 Long	1.6

# T-5 Lamp

- † **New Technology**
- † **Direct/Indirect Application**
- † **Layout Dependent**
- † **More Reflectance Efficiency**
- † **Potential Fixture Count Reduction**
- † **Energy Cost Reduction**
- † **Something to Watch!**

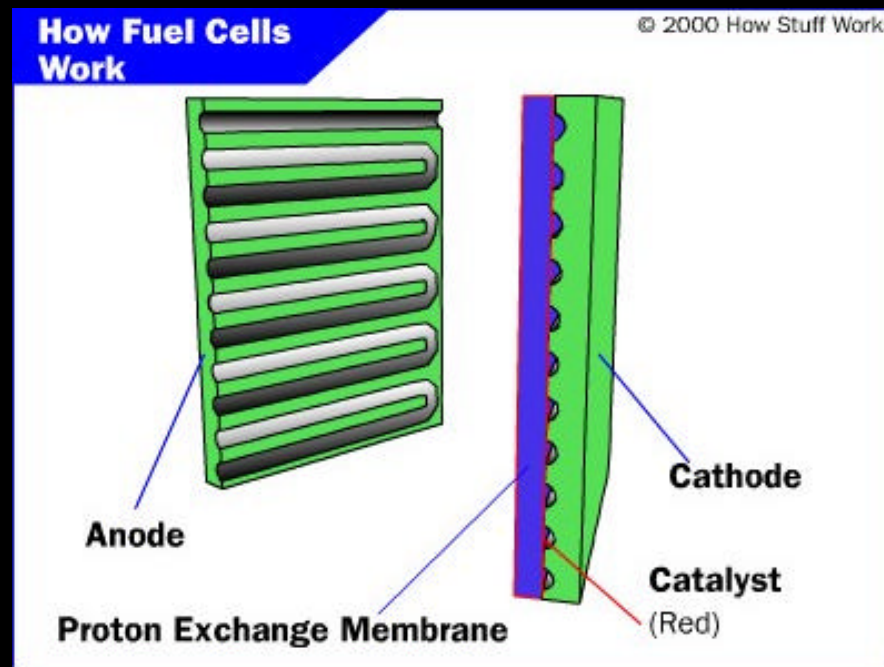


# #1 “Not Quite Ready for Prime Time”

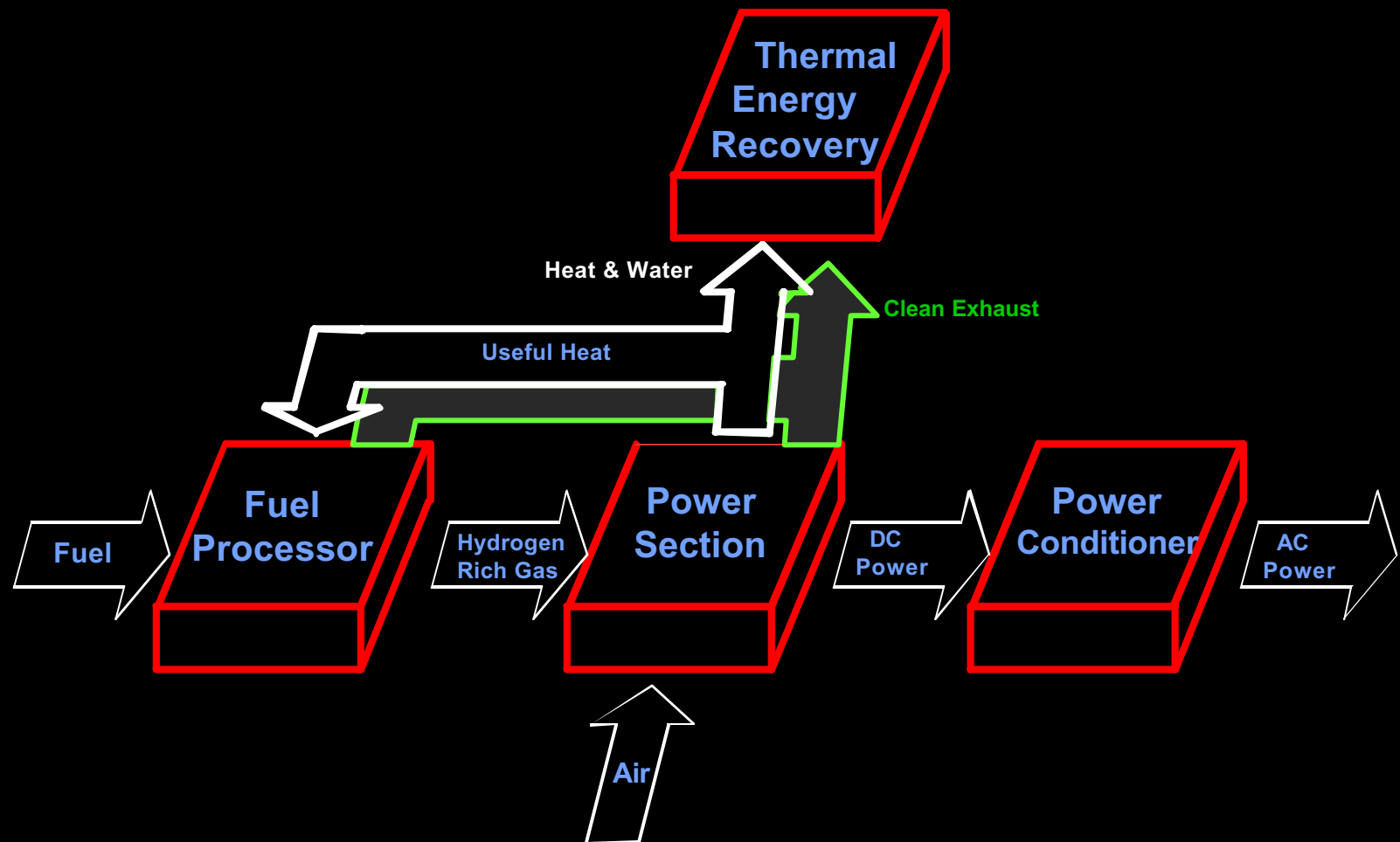
## Fuel Cells

# What are Fuel Cells?

† **Electrochemical device converting fuel directly into electrical energy without the need for combustion.**

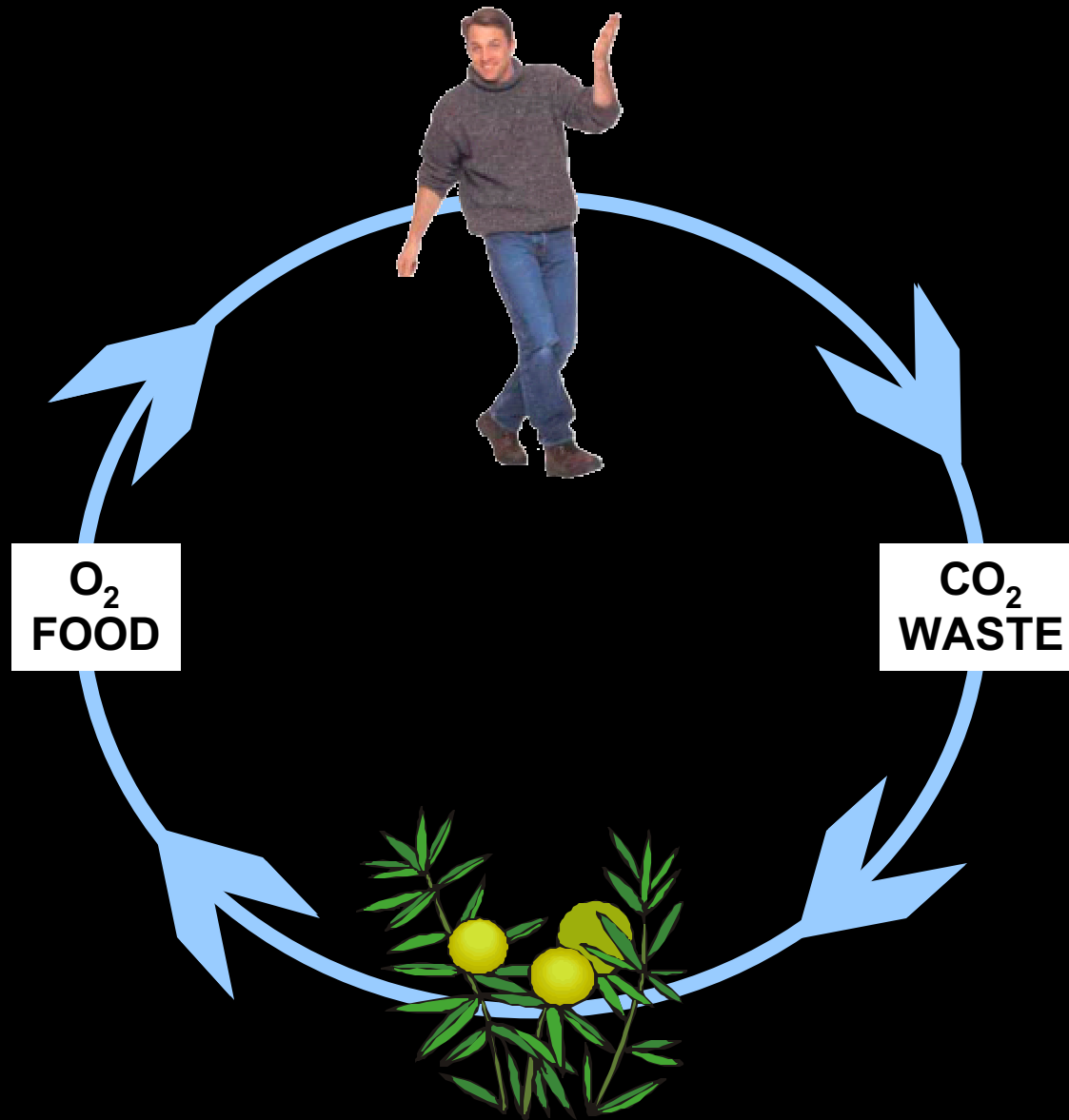


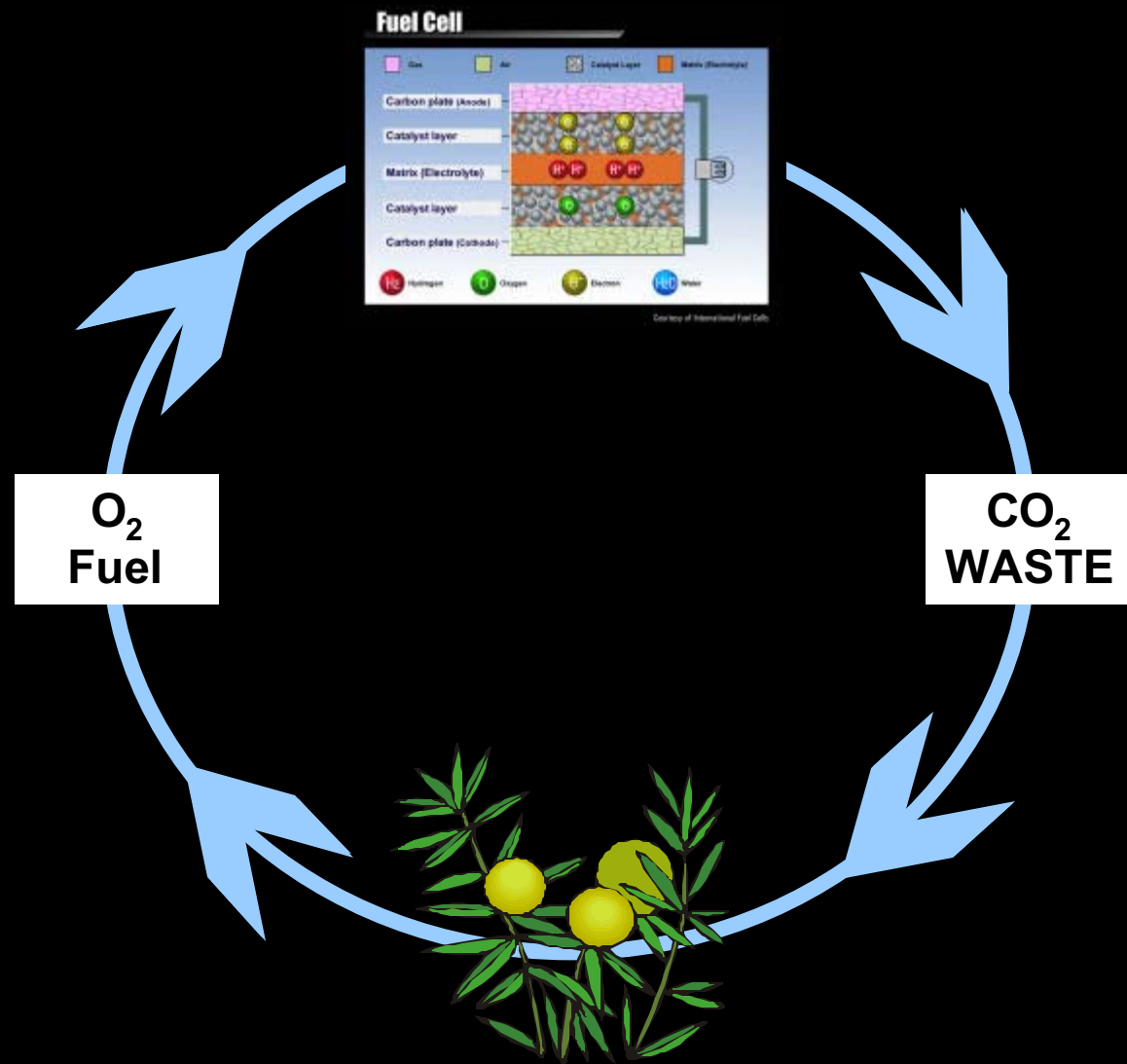
# Fuel Cells - How Do They Work?



# Fuel Cells - How Do They Work?

[Fuel Cells.exe](#)



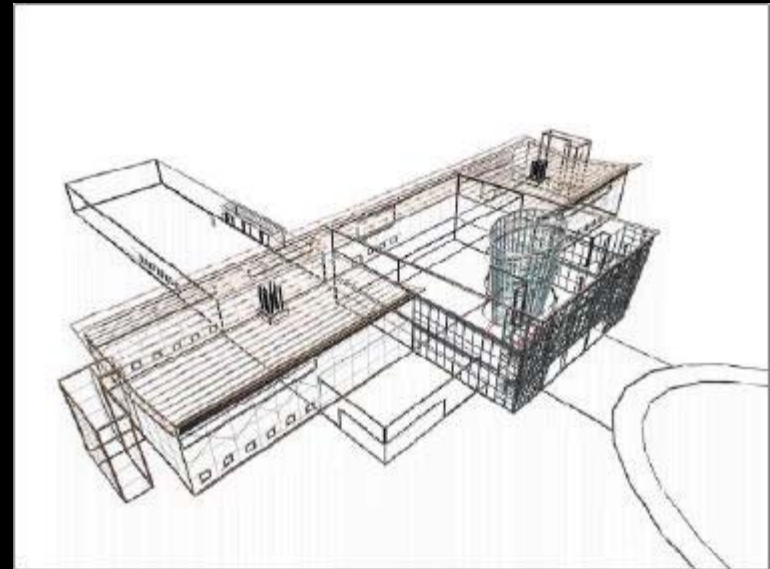


# NASA – *Space Experiments Research Processing Laboratory*

† **Research into Sustainable Micro-Environment**

† **Fuel Cell Leader**

† **Desire to be a “Model” Project**



*Space Experiments Research  
Processing Laboratory*

# NASA SERPL - Life Cycle Cost Analysis

Project Equipment Comparative Alternatives	Initial Cost (Delta) Present Value	Life Cycle Cost Present Value
† 600 Ton Electric Centrifugal Chiller † 6280 mbh Hot Water Boiler † 1250 KW Diesel Generator	\$8,500	\$41,000
† 600 Ton Natural Gas Direct Fired Chiller w/ Heat Recovery † 800 KW Generator	\$11,000	\$76,000
† <b>1250 KW Fuel Cell</b> † 600 Ton Centrifugal Chiller † 3800 mbh Hot Water Boiler	\$2,800,000	\$2,834,000

# Fuel Cells - Advantages

- † High Quality Power
- † High Level of Reliability
- † Continuous Operation
- † Low Emissions and Noise
- † Potential for Cogeneration



# Fuel Cells - Disadvantages

✚ **First Cost**

✚ **Limited Availability**

✚ **Relatively New Commercial Market**

# Future of Fuel Cells



*Cars*



*Cell phone battery*

† **Reduced Cost Through Mass Production**

† **Increase in Heat Quality for Cogeneration**

# Q & A